



# Air Force Research Laboratory|AFRL

*Science and Technology for Tomorrow's Air and Space Force*

## **Success Story**

### **COMPOSITE PATCH VACUUM-MOLD REPAIR SYSTEM TRANSFERRED TO COMMERCIAL INDUSTRY**



Vacuum-mold repair system (VMRS) technology dramatically reduces the time required to undertake multiple contour, metal aircraft structure repairs at field locations. The process uses a quick, reusable mold for transferring the contour of an equivalent undamaged metal structure and laying-up of a graphite-epoxy composite patch.

The new system also incorporates an integral heating device and other equipment that, when packaged together, provide a complete composite repair kit. VMRS can replicate the contour of a damaged aircraft part in less than 10 minutes versus several hours required by current splash molds, which are not reusable. As a result, technicians are able to complete their repairs and return the aircraft to flying status much faster.



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## Accomplishment

The VMRS, a revolutionary composite patch repair system developed by the Air Vehicles Directorate (formerly the Flight Dynamics Laboratory) and built by Lockheed Martin Corporation, reduces the amount of time required to complete metal aircraft structure repairs at field locations. The Materials and Manufacturing Directorate's Materials Integrity Branch refined the VMRS technology, demonstrating promising results during extensive testing before transferring the technology to commercial industry. Airtech Advanced Materials Group obtained a license to produce and sell this new technology, which they have entitled the Impression Master®.

## Background

Prior to the development of vacuum-mold repair, the most effective way to repair metal aircraft structures depleted from excessive wear and fatigue or damaged in combat was to fly the aircraft to a maintenance depot or complete the repairs at a field location using conventional splash-mold techniques. Splash-mold techniques, using plastic or ceramic curing compounds, are effective in repairing multiple contour structures; however, they are also costly and time-consuming, since they require one-time use molds.

Splash-mold techniques require large quantities of repair materials to complete several repairs. They also necessitate an unacceptably long downtime of an equivalent undamaged aircraft while the mold is curing.

Another disadvantage of splash-mold techniques is that the composite material handling and processing methods employed require cold storage of materials using "clean room" equipment that is bulky, heavy, expensive, and requires extensive training and experience. Transport of aircraft to maintenance depots for metal aircraft structure repair is very expensive and often creates logistics problems, since maintenance workers work the repairs in around periodic maintenance already scheduled or in progress.

VMRS employs a mechanically hardened tooling technique that uses a sealed rubber bag containing lightweight granular filler. Once positioned over the damage location of an equivalent aircraft, the maintenance technician draws a vacuum within the bag, which causes the rubber skin to constrict on the filler, locking it in a firm arrangement and replicating the surface geometry of the damage location.

## Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-ML-33)